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DEPARTMENT OF COMMERCE

BUREAU OF STANDARDS

WASHINGTON

ADDRESS REPLY TO
BUREAU OF STANDARDS

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GENERAL NOTE.

Owing to the current nature of the investigations mentioned in the Technical News Bulletin, sometimes it will be impossible to supply printed information regarding them. However, in these cases, when the investigation has progressed sufficiently far, the Bureau will be pleased to furnish technical data to those engaged in the particular application of the subject, in order to avoid the delay incident to publication.

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Cooperation of the Bureau of Standards with the Army and Navy in the Field of Radio Communication

It is perhaps not generally known that besides the radio laboratory of the Bureau of Standards there have have been maintained at this institution two other laboratories for radio research work, one conducted by the Navy Department, and the other by the Signal Corps of the Army. They have worked in close cooperation and important results have been produced thereby which greatly aided the work in radio communication during the war. Cooperation between three such organizations is of great advantage in a field which is developing and changing so rapidly as that of radio communication.

On account of the location of these laboratories at the Bureau of Standards, the French Scientific Mission, which visited this country immediately after the entry of the United States into the war, likewise made its headquarters here and deposited a large amount of French Radio apparatus in the Bureau's laboratory which greatly assisted in the rapid development of radio apparatus for the military and naval forces. Many inter-departmental radio conferences were held here in which problems of radio communication were discussed and programs of development were laid down.

The radio work of the Bureau at the present is divided into two sections,- radio research and testing, and radio development. The first includes the

investigation of the properties and phenomena of audio waves and antennas, electron tubes, and amplifiers, radio telephony and associated problems, such as multiplex telephony, insulating materials, and the testing of radio instruments and measurements of various kinds. The radio development work includes the development of the radio direction finder and its application to aerial and navigational uses and the development of instruments for the use of the radio inspectors of the Bureau of Navigation of the Department of Commerce.

2 Cooperation of the Bureau of Standards with Radio Laboratories of Universities

The radio laboratory of the Bureau of Standards has been of considerable assistance to the research laboratories now maintained at numerous universities. The Bureau has been able to offer suggestions for research work, technical data and publications, and advice upon particular problems. It has likewise assisted in the standardization of instruments and apparatus for university laboratories. Cooperation of another sort has been furnished through the reading and criticizing of papers and books prepared by university research workers and the radio instruction has been facilitated by the use of two of the publications prepared at the Bureau's laboratory, namely, The Principles Underlying Radio Communication, and Radio Instruments and Measurements.

Much of the research work at present in progress at the Bureau is of a sort in which direct cooperation can readily be carried on between the Bureau and the universities. This work includes the study of radio waves and their behavior. University workers who desire to cooperate in this research will be assisted by the Bureau and arrangements will be made to standardize apparatus which they use in order to insure reliability of results. In connection with this work, the following radio laboratory reports are available: Suggestions for Radio Research; Fees for Testing Radio Apparatus; A List of Manufacturers of Radio Apparatus, and a List of Manufacturers of Electron Tubes.

3 Radio Measurements

The work of the radio laboratory includes the testing of wave meters, condensers, ammeters, and many types of special instruments and devices of importance in radio work. The standards of wave length established by the Bureau have been used as the basis of wave length measurements in this country and also to check similar

measurements made abroad. These measurements are of importance in preventing different radio stations from interfering with one another, which is one of the essential limitations of radio communication.

In view of the prospective international regulation of wave lengths on a more exact basis than anything heretofore attempted, particular importance attaches to the measurements which are in prospect upon a new and more accurate method for establishing a fundamental basis for wave length standardization. One of the principal elements of all radio circuits is the condenser and a special type designed at the Bureau has been further improved by recent experiments. Such condensers are used as standards, both in wave length measurements and in determining the power loss in insulating materials and radio apparatus. The condenser should be free from power loss and the type developed at the Bureau appears to be the most nearly perfect in this respect of any type available. Important information for the design of radio apparatus may be obtained by stating the wave forms of the currents used in radio sets. Special apparatus has been devised at the Bureau for this purpose and by means of the cathode ray oscillograph it is possible to trace out a wave form of currents which alternate millions of times per second. Recently these instruments have been used in the study of the current in electron tube transmitting sets of a new type for radio telegraphy and telephony.

Previously there has been but little information available concerning the electrical properties and behavior of the telephone receivers used in radio work. Such receivers are of a different type from those used in ordinary telephone work and their properties affect the behavior of other radio apparatus. Methods have been developed and measurements made to determine the electrical resistance and impedance of telephone receivers and to determine the magnitude of the response of the receiver to various kinds of current. The results of this research will be of importance to telephone receiver manufacturers and users, and will also facilitate the making of accurate measurements on the currents received in radio stations.

4 Recent Radio Publications

The following publications on radio measurements have been prepared:

High Frequency Ammeters, Scientific Paper No. 206;

Direct-Reading Instrument for Measuring Logarithmic Decrement and Wave Length of Electro-Magnetic Wave, Scientific Paper No. 233;

Measurement of Radio Frequency Resistance, Phase Difference, and Decrement;

Principles of Radio Transmission and Reception with Antenna and Coil Aerials, Scientific Paper No. 354;

Radio Instruments and Measurements, Circular No. 74.

The latter publication is a comprehensive treatise of 341 pages. In addition to the publications listed, a number of reports on particular kinds of measurement have been prepared and a limited supply of copies in typewritten form is available to specialists in this particular work.

5 Amplifiers of Speech and Radio Signals

The electron tube has several times been mentioned in previous numbers of the Bulletin. This is such a recent development that as yet there are no standards of performance by which these devices are rated, and there are few of the generally recognized principles of electrical design by which an amplifier can be produced for a particular purpose without extensive and costly experimental work. With the idea of standardizing the construction of these devices, the Bureau is conducting an exhaustive experimental and theoretical investigation of all available types of amplifiers of both foreign and American design. It is expected that two important results will be secured: (1) the establishment of standards of operation for each type of amplifier according to which manufacturers can rate their product; (2) principles of design will be formulated, data on constructional details will be assembled and all such information made available for the use of those interested in methods of electrical communication and the reproduction of sound.

6 Insulating Materials

For some time, the Bureau of Standards has carried on an extensive investigation of the electrical and mechanical properties of insulating materials giving particular attention to their behavior at radio frequencies. The information thus secured assists in the design and utilization of such materials for electrical and radio apparatus. The research will include the effects of moisture and other tests to

determine the practical usefulness of various materials under operating conditions. Special study has been made of bakelite and other materials of a phenol-methylene type, but other materials, such as glass, mica, celluloid, electrosote, paraffin, fiber, hard rubber, porcelain, and wood, will be included.

7 Investigation of Airship Instruments

Recently an investigation of certain special instruments has been made for the military authorities including rate-of-climb indicators of a German type, a thermograph, and balloon manometer of the diaphram type. In the last-named instrument, the use of a sensitive diaphragm is carried to a high degree of refinement. Conferences have been held between the Bureau's experts and the authorities of the Army and Navy at three of the dirigible stations regarding the practical needs in this work. A study has been undertaken of methods for developing the necessary new instruments called for, including special altimeters and air speed indicators to give high precision at lower altitudes and lower speeds than those manufactured for airplanes. An air volume integrating instrument is also needed to measure the flow of air into the envelope to secure proper buoyancy and economy in the use of hydrogen.

8 Altitude Effect of Air Speed Indicators

This investigation is nearing completion and the water channel and vacuum wind tunnel experiments may now be interpreted as showing conclusively (1) that the compressibility of the air may legitimately be left out of account in determining the law of action of the usual Venturi tubes; (2) that viscosity must not be neglected in low speed flights, thus introducing a new property of the atmosphere hitherto ignored; (3) that at low speeds the indication of the Venturi, contrary to the assumption hitherto made by all users of this type of indicator, is not directly proportional to the air density, nor is it proportional to the square of the speed, but departs noticeably from this relation.

Through the courtesy of the Air Service, the Bureau's expert on the above subject has conducted flight tests at McCook Field which have afforded a practical check against the numerical results of the previous laboratory experiments. As soon as these results can be made available, they will be of importance in connection with airplane performance tests whenever high precision is required, and more particularly in connection with air speed observations on dirigibles.

9 Investigation of Ground Speed Indicator

A further study has been made of the requirements for a successful ground speed indicator together with experimental trials of a preliminary model. The chief requirement is a suitable stabilizer to hold the instrument in a horizontal position. A rigorous theoretical formula has been determined which serves as a criterion for the amount of departure from the true horizontal position that can be permitted without exceeding any given limit of error on the ground speed.

10 Improvements in Commercial Altimeters

Quite often a certain line of research work will produce results not at first contemplated but perhaps as important as the result of the main investigation. In connection with the development of the large precision altimeter, it has been discovered that a very useful improvement can be made in the method of support of the mainspring of commercial altimeters. After making this improvement in certain instruments, tests show that the lag has been reduced to one-half its original value.

11 Instrument Salvage

Salvage work for the Aerial Mail Service of the Post Office Department has been inaugurated by the overhauling and re-adjustment of a group of about 30 instruments of various types which have been damaged in service or found defective. A report on general methods for instrument salvage is in preparation. A large quantity of barographs and recording air speed indicators have been submitted by the Air Service for salvage, calibration, and, in some instances, for extension of the altitude scale by re-design of the movement.

12 Mercurial Standards for Blood Pressure Gages

Recently the Bureau has undertaken an investigation of the various types of blood pressure gages in use throughout the country. There appears to be a great variation in the instruments employed and the Bureau has constructed what is believed to be the first fundamental mercurial standard for testing sphygmomanometers. It is hoped that as a result of this work more accurate instruments can be constructed.

13 Comparative Fatigue Tests on Iron and Copper Tubing

These tests are in progress but as yet no final results have been obtained. Preliminary data would seem to indicate that the iron pipes are seriously weakened by surface irregularities and especially by the maker's name stamped on the pipe. In three out of four specimens which failed at exceptionally low

numbers of repetition of stress, the failure started in one of the letters of the stamped name. All later specimens were cut so as to place the name stamp outside the stressed portion of the pipe.

4 Investigation of Columns Constructed of Green Timber

It was necessary to use green timber in the construction of the temporary war buildings in Washington. Recently some of the wood columns in these buildings have warped and cracked in seasoning. Several such columns were submitted for test by the Superintendent's Office of the State, War and Navy Departments' buildings, to ascertain the effect of the seasoning on the strength of the columns. The tests showed that where warping and bending had taken place the strength was appreciably reduced. In the case of columns where excessive bending had developed, the strength was so reduced as to render them unsafe, but cracking due to seasoning did not weaken the columns as long as they remained straight.

15 Physical Constants of Interest to the Refrigerating Industries

Of the numerous investigations on physical constants of materials which are being conducted at the Bureau, a number that are of particular interest to the refrigerating industries have recently been completed and the results prepared for publication. The physical properties of ammonia are of greater concern to these industries than those of any other material, since ammonia is the medium used in by far the largest number of refrigerating plants. Two recent papers deal with the vapor pressure of saturated ammonia and with the densities of the liquid and of the saturated vapor. In connection with the determination of the vapor pressures, use was made of a pressure gage of unique construction which proved to be very accurate. Another paper dealing with the specific heats of sodium chloride solutions, known as brine, used in the making of artificial ice, has also been completed. These papers will be published in the course of the next few months in the Journal of the American Society of Refrigerating Engineers and a more detailed account will be published later by the Bureau.

16 Carburetion of Airplane Engines

During the past month, the work in the carbureter laboratory has been confined mainly to a study of the conditions occurring in an intake manifold as represented by measurements of temperature of the gasoline-air mixture. The object of this research is to discover whether means can be found for determining the physical

condition of mixtures as they enter the engine cylinder, since a knowledge of this condition is of the utmost importance for the proper utilization of the heavier grades of fuel which are now in common use.

17 Ignition Apparatus for Internal Combustion Engines

The principal work recently carried on under this head has been the development of the mathematical theory of the building up of voltage in the secondary winding after the opening of the primary breaker. In connection with this work, methods have been developed for measuring the effective secondary capacity of the windings which have given results in close agreement with those obtained by computation from the dimensions of the coil. Recently the collection of data on 9 magnetos, which have been received by the laboratory since the preparation of the reports on this subject, has been resumed. The ratio of transformation and coupling coefficient has been determined on all these machines and measurements of the mutual inductance are now in progress.

At the request of the Motor Transport Corps, specifications were prepared for laboratory tests on magnetos to be used as a basis for their purchases for the U. S. Army.

18 Photographic Method for Measuring the Elongation and Lateral Deformation of Steel

Experiments have been made upon a photographic method of measuring the elongation and lateral deformation of steel during tensile tests. The purpose of the method is to determine the action and properties of some special test specimens when stressed beyond the elastic limit, especially to determine, if possible, a relationship between the elongation and the lateral deformation.

19 Camera for Photographing the Interior of Service Rifle Barrels

For many months the Bureau has been engaged in perfecting a special camera for taking panoramic photographs of the interior of a gun barrel. Previously when it has been desired to study the effects of erosion on guns, it has been necessary to saw the barrel in two lengthwise after firing a certain number of rounds. It appeared desirable to develop a means whereby such an investigation could be carried on without destroying the gun, and it is with this object in mind that this camera has been designed. The design of the lenses has already been perfected and the camera itself is being constructed by one of the Bureau's mechanics.

20 Recent Chemical Publications

The following publications dealing with various chemical problems have recently appeared:

1. A New Hexabromide Test for Linseed Oil, published in the Journal of Industrial and Engineering Chemistry, January, 1920;

2. Specifications for Basic Carbonate White Lead, Bureau of Standards Circular No. 84;

3. Constant-Temperature Still Head for Light-Oil Fractionation, Bureau of Standards Technologic Paper No. 140, (also in the Journal of Industrial and Engineering Chemistry, January, 1920);

4. Detection and Determination of Glue in Rubber Goods, to appear in the Rubber Age, and as a Bureau of Standards Technologic Paper.

21 Progress of Tests of Tile Concrete Floor System

A live load of about 200 lb. per sq. ft. has been applied to the 50' x 115' slab, test of which is now in progress at Waynesburg, Ohio. Very little stress in either the concrete or steel are reported to have occurred. The difficulty of doing accurate instrument work on an unprecedentedly large scale has been greatly increased by the very cold weather and the heavy snowfalls which have occurred during the month. The test is unusual, not only on account of the size of the slab, but because of the peculiar conditions under which it is being conducted.

22 The Compressive Strength of Concrete

A paper on the compressive strength of concrete in beams is being prepared with the expectation that it will be presented at the next meeting of the American Concrete Institute. The paper is based on the results of tests made by the Bureau of Standards at Lehigh University and Lafayette College in 1918, and the extensive tests made at the Structural Materials Laboratory by the Geological Survey at St. Louis from 1904-1910.

23 Cal and Calcium Chloride Investigation

Cal which had been stored in a cloth bag for about three years was compared with approximately fresh material to discover its effect on the hardening of Portland cement mortar. Amounts were used which contained equal quantities of chlorine. The results indicate that Cal does not lose its effectiveness as an accelerator upon exposure to the air. Work has been started with the object of determining the true composition of calcium-oxychloride crystals and their optical constants. Some conflicting data appear in the literature with reference to the composition of this salt, but none at all have been found which give the optical constants. This is important in

connection with the work on Cal, as it is believed that this substance is essentially calcium-oxychloride. A manuscript is being prepared to be submitted as material for a Technologic Paper which will give in detail the work done on Cal.

24 Hardening of Concrete Laboratory Floors

In concreting one of the laboratory floors, practical tests of the effect of Cal and calcium chloride on the rate of hardening of the top course mortars were made by comparing the rate of hardening of both treated and untreated mortar. The accelerated mortar was prepared by adding 5 lb. of Cal per bag of cement in the 1:2 mortar used for the topping. The relative rate of hardening of both the untreated and treated mortars was measured by the flow table method and the opinion of the floor finishers, as to the hardening of the mortars, was also obtained. Both mixes, when made, had a flow of 255; when 3-1/2 hours old, the untreated mix had a flow of 186, while the one treated with Cal had practically no flow. Up to 1-1/2 hours, the flow of the two mixes was practically equal, while at 3-1/2 hours the accelerated topping had set to such an extent that it was difficult to trowel, while the plain topping was too soft to finish properly. The finishers' opinions coincide with the results of the rate of hardening tests. In other topping used in the floor, the saturated solution of calcium chloride in proportion to give a slightly less chlorine content than the Cal was used, and similar early hardening was obtained as in the case where the Cal was added. In both cases, it was possible to finish the treated mortar in one-half the time necessary for the untreated mortar.

25 The Effect of Striae in Optical Glass on Resolution

The work on the design of a proper resolution chart, which is preliminary to the investigation of the effect of striae on the resolution of an optical system, is nearly completed. A report on this preliminary work is being prepared which presents curves showing the relation between the resolution of a telescope and the intensity of the illumination of the test chart. Other curves plot the relation of the resolution to the degree of contrast between the background of the chart and the lines ruled thereon. These curves were obtained using charts of various types, such as a 1 mm line with sharp edges, two or more narrower lines, etc. The

results so far obtained warrant the belief that considerable assistance may soon be extended to the manufacturer who is called upon to decide how much striae he should allow in the prisms or lenses in his optical instruments.

26 Specifications for Sextants

The specifications for the best grade of sextants, as demanded by the Navy, have been revised, requiring a certain grade of performance in the finished instrument rather than any definite procedure in details of manufacture. A method for the testing of sextants has been devised which will enable the Bureau to operate independently of the Naval Observatory or other laboratories when instruments are sent here for test.

27 American-Made Refractometer

A refractometer of the Abbé type, manufactured by W. P. Valentine of Haddonfield, N. J., was tested for the accuracy of the scale readings. This American-made instrument so far has proved as satisfactory and accurate as any of the foreign ones, which fact should give encouragement to American instrument makers engaged in the field of manufacturing of precision optical instruments.

28 Micro-structure of Steel Subjected to Sudden and Extreme Heating

A Martensite structure has been observed in the superficial layers of metal in the bores of guns and pressure plugs that have been in service. Presumably this structure, which characterizes a steel suddenly cooled from high temperature, is due to the rapidly developed high temperatures at the time of firing followed by sudden cooling. If such an explanation is correct, it should be possible to develop a similar micro-structure by the sudden heating and cooling of the metal produced by the intermittent discharge of an electrode close to the metal surface. Experiments which appear to demonstrate that this is true have been completed and a paper on the subject is now in preparation.

29 Tests of Precision Weights

In Bulletin No. 31, issued on November 5, 1919, there appeared a paragraph under this heading which states "A great many of the weights submitted by American makers have been unsatisfactory. This has caused such great delay and inconvenience that one of the largest dealers is already considering the advisability of importing at least those weights which are to be certified by the Bureau. This is unfortunate

and apparently the trouble is mainly due to insufficient factory inspection."

Since the above statement was issued, the Bureau has received a number of letters and has had its attention called to several magazine articles dealing with the subject and which apparently interpret the Bureau's statement in an erroneous way. Most of these articles and letters have interpreted the paragraph as meaning that foreign weights in general are better than those of American manufacture. Such a statement is absolutely unwarranted. The paragraph in the Bulletin distinctly states that the unsatisfactory performance of certain American weights was probably due to unprecedented manufacturing conditions. The statement was made with the intention of aiding and not of injuring the American industry, and the erroneous interpretation which it received is to be regarded as extremely unfortunate.

Respectfully,

S. W. STRATTON

Director

HCB